

Sandia engineers world's most wear-resistant metal alloy

By Troy Rummler

If you're ever unlucky enough to have a car with metal tires, you might consider a set made from a new alloy engineered at Sandia. You could skid — not drive, skid — around the Earth's equator 500 times before wearing out the tread.

Sandia's materials science team has engineered a platinum-gold alloy believed to be the most wear-resistant metal in the world. It's 100 times more durable than high-strength steel, making it the first alloy, or combination of metals, in the same class as diamond and sapphire, nature's most wear-resistant materials.

Sandia's team recently reported its findings in *Advanced Materials*. "We showed there's a fundamental change you can make to some alloys that will impart this tremendous increase in performance over a broad range of real, practical metals," said materials scientist Nic Argibay, an author on the paper.

Although metals are typically thought of as strong, when they repeatedly rub against other metals, like in an engine, they wear down, deform and corrode unless they have a protective barrier, like additives in motor oil.

Costly coating burnout

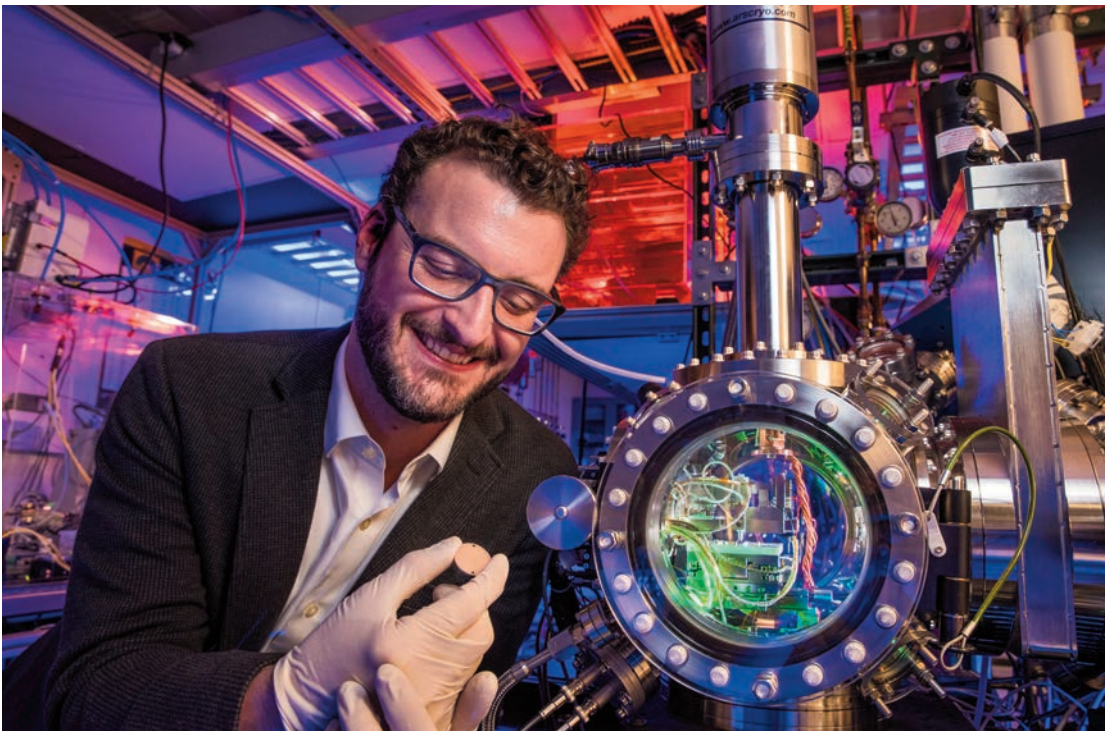
In electronics, moving metal-to-metal contacts receive similar protections with outer layers of gold or other precious metal alloys. But these coatings are expensive. And eventually they wear out, too, as connections press and slide across each other day after day, year after year, sometimes millions, even billions of times. These effects are exacerbated the smaller the connections are, because the less material you start

with, the less wear and tear a connection can endure before it no longer works.

With Sandia's platinum-gold coating, only a single layer of atoms would be lost after a mile of skidding on the hypothetical tires. The ultradurable coating could

save the electronics industry more than \$100 million a year in materials alone, Nic says, and make electronics of all sizes and across many industries more cost-effective,

(Continued on page 3)



PRECIOUS METAL — Sandia researcher Nic Argibay holds a platinum-gold sample, standing next to a friction and wear testing apparatus like those used to demonstrate the extraordinary wear resistance of the highly stable nanocrystalline alloy. (Photo by Randy Montoya)

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Blast tube tests at Sandia simulate shock wave conditions nuclear weapons could face

By Sue Major Holmes

You can learn a lot from a blast tube. You can learn more when you couple blast experiments with computer modeling.

Sandia researchers are using a blast tube configurable to 120 feet to demonstrate how well nuclear weapons could survive the shock wave of a blast from an enemy weapon, and to help validate the modeling.

Sandia has completed a two-year series of blast tube tests for one nuclear weapon program and started tests for another. Each series requires instrumentation, explosives, high-speed cameras and computer modeling.

Tests simulate part of the environment a weapon re-entering the Earth's atmosphere would face if another nuclear weapon went off nearby, said test director Nathan Glenn.

Each series starts with calibration shots that allow team members to verify blast wave parameters and at the same time validate the computer model. The team hangs an explosive charge at one end of the 6-foot diameter tube and places pressure transducers along its length. Transducers sense the strength of the blast pressure moving through the tube — higher pressure closer to the charge, falling off farther away.

Modeler Greg Tipton, who helped design the series, said tests validate the computer models of the structural dynamics of the system. "We can then use the models to simulate real environments we can't actually test to," he said.

Figuring out how to conduct testing

It's complex just to analyze how to conduct a test, Greg said. The pressure drives how big a charge is needed and how the test article is positioned in the tube, and that determines the loading, or the amount of force applied to the test unit. In turn, the loading

determines the structural response of the test article. "So, the team does end-to-end calculations to simulate the explosive going off, the shock wave through the tube, the shock propagation over the test unit and then the structural response to the shock wave. All of that data is used to determine the right orientation, the right shock level, to validate the models," Greg said.

One software program simulates the explosive going off and the shock wave moving through the tube. A second calculates the shock moving over the test unit. A third computes the unit's response to shock and vibration. The fourth simulates how the unit will fly from the tube so the team can estimate where it's going, how fast it's moving and how they're going to catch it safely. Each software package has the dual purpose of computing the response of the system to validate the models and helping design the test, Greg said.

Software that simulates the explosive going off, for example, helps determine the size of the charge.

"They do a number of shots in the tube to calibrate that. You know a charge weight and a pressure at some target location," he said. "As you up the charge weight, you're going to up the pressure, and if you do a handful of those tests and a whole bunch of simulations to fill in the blanks, you establish a calibration curve that tells you how much explosive you need to achieve a target pressure."

Wil Holzmann, who helps analyze test data, said more than a hundred channels of data might be collected on pressures, strains and acceleration responses.

(Continued on page 7)

THREE...TWO...ONE — Sandia researchers use a blast tube to demonstrate how well nuclear weapons could survive the shock wave of a blast from an enemy weapon and to help validate the computer modeling. (Photos courtesy of Sandia National Laboratories)



Sandia Science & Technology Park celebrates 20 years, announces positive economic impact

Park responsible for \$3.1 billion in economic activity since 1998

By Manette Newbold Fisher

The Sandia Science & Technology Park, home to 26 buildings, 47 companies and organizations and more than 2,050 jobs, celebrated its 20th anniversary last week and highlighted the park’s economic impact through 2017.

Sandia Director Steve Younger joined Albuquerque Mayor Tim Keller at SolAero Technologies Corp. to release findings of a new report by the Mid-Region Council of Governments.

The SS&TP, a 300-plus acre master-planned park located outside Sandia Labs and Kirtland Air Force Base, has generated \$3.1 billion in economic activity since it was established in 1998, the report concluded. Called taxable personal consumption in the report, economic activity refers to spending on goods and services, government expenditures and private investments.

During the same period, the park also produced more than \$123.4 million in tax revenue for the state of New Mexico and \$22.5 million for the City of Albuquerque.

which generates tremendous economic impact for Albuquerque and surrounding communities.

“The Science & Technology Park has spurred growth in the Southeast Heights while providing a gateway to science and technology for our community,” Keller said.

“This park is an example of a project that hits the mark on placemaking and ensures we’re creating areas that will make our city succeed.”

From ground-breaking to growth

Celebrating at SolAero was significant because the SS&TP broke ground there in May 1998, said Jackie Kerby Moore, Sandia’s manager of Technology and Economic Development. The site initially housed



A PREMIER TECH PARK — Since it was established in 1998, the Sandia Science & Technology Park has grown from one company to 47 and has generated \$3.1 billion in taxable personal consumption for the state of New Mexico. (Photo by Norm Johnson)

EMCORE, the first park business. EMCORE transitioned to SolAero through an acquisition in 2014.

Sherman McCorkle, chairman of the board of the SS&TP Development Corp., said, “From a recovered brownfield to the premier science and technology park with more than \$3 billion in economic impact in less than 20 years is a feat every state will envy. Our success comes from the outstanding collaboration from the many partners who make up the park.”

Along with celebrating the 20th anniversary and announcing the

park’s economic impact, SS&TP recently received a Star of the Southwest Award at the Southwest Region Economic Development Association’s Conference in July. The award recognized the park for its economic impact success and for playing a meaningful role in Albuquerque’s future.

Jobs, wages and widespread investment

Jobs associated with the research park, which houses private companies and some Sandia National Laboratories sites in a collaborative environment, have paid out \$5.4 billion in wages from 1998-2017, contributing significantly to the local economy, according to the report.

The report found that salaries for full-time employees of companies and organizations in the SS&TP last year averaged \$98,000. The average salary for full-time employees in the Albuquerque metro area is \$46,000.

“High-paying jobs have a benefit for the city of Albuquerque and for the region as a whole,” said Dewey Cave, executive director for the Mid-Region Council of Governments. “The park continues to bolster the economy by providing competitive salaries, long-term employment and first-rate jobs.”

In 2016 and 2017, the park’s economic impact was \$388.7 million in taxable personal consumption, and it produced \$15.4 million in tax revenue for the state and \$6.6 million for the city. Wages in the two-year period totaled \$747.7 million, according to the report.

Investments in the park since 1998 total more than \$384.8 million, with \$295.8 million coming from private sources and \$89 million coming from public investment.

The park is a partnership of Albuquerque Public Schools, Bernalillo County, City of Albuquerque, Mid-Region Council of Governments, New Mexico Congressional Delegation, New Mexico State Land Office, Public Service Company of New Mexico, Sandia National Laboratories, Sandia Science & Technology Park Development Corp., State of New Mexico, Union Development Corp., U.S. Department of Energy/ National Nuclear Security Administration and U.S. Economic Development Administration.

Lab News Notes

Editor’s Note: Lab News seeks guest columnists with observations on life at the Labs or on science and technology in the news and in contemporary life. If you have a column (500-750 words) or an idea to submit, please contact Jim Danneskiold, the acting editor.



20 YEARS AND COUNTING — During the Sandia Science & Technology Park economic impact news conference on Aug. 24, Albuquerque Mayor Tim Keller announced the park has paid out \$5.4 billion in wages since 1998. Behind him, Labs Director Steve Younger, NNSA Sandia Field Office Manager Jeff Harrell and SS&TP Executive Director Jackie Kerby Moore listened in. The news conference highlighted the park’s 20th anniversary, successful partnerships, job creation and growth.

(Photo by Randy Montoya)

Steve congratulated the park on 20 years of success. He said the Labs benefit from the SS&TP, empowering Sandia researchers with increased access to partners.

Labs committed to park partnership

“The Sandia Science & Technology Park is a successful public-private partnership that has had a positive impact on the community,” Steve said. “Sandia is committed to continuing to grow the park through collaboration, bringing long-term, high-quality jobs and economic prosperity to the city, county and state.”

Keller said the city is proud to be active in the park,

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Ray Thomas led work at Sandia accelerators, CERN experiments

Ray Thomas, a Sandia manager, passed away last month.

Ray led the organization that provides telemetry and advanced electronic services and support to Nuclear Deterrence and National Security Programs mission areas.

Previously, he was the department manager for the accelerator operations organization responsible for HERMES III, SATURN and SPHINX.

“Ray was a kind person, always willing to go above and beyond to help his colleagues,” said senior manager Tom Trodden. “He was a voracious learner, and the organization leaned on him as an SME in many technical and safety areas for advice and guidance.”

Ray began his career at Sandia in 2004 working on the Z machine.

He earned his master’s and bachelor’s degrees in physics from Texas Tech University.

“Of all his achievements, Ray was most proud of his service to our country as a member of the United States Marine Corps,” Tom said.

Tom said Ray was a member of the team that worked on the Compact Muon Solenoid experiment at the Large Hadron Collider at the European Organization for Nuclear Research, or CERN.

Ray is survived by his wife, Dawn Thomas of Sandia’s transportation analysis department, and a son, Dillon Thomas.



RAY THOMAS
(Courtesy photo)

Metal alloy

(Continued from page 1)

long-lasting and dependable — from aerospace systems and wind turbines to microelectronics for cell phones and radar systems.

“These wear-resistant materials could potentially provide reliability benefits for a range of devices we have explored,” said Chris Nordquist, a Sandia engineer not involved in the study. “The opportunities for integration and improvement would be device-specific, but this material would provide another tool for addressing current reliability limitations of metal microelectronic components.”

New metal puts an old theory to rest

You might be wondering how metallurgists for thousands of years somehow missed this. In truth, the combination of 90 percent platinum with 10 percent gold isn’t new at all.

But the engineering is new. Nic and coauthor Michael Chandross masterminded the design and the new 21st century wisdom behind it. Conventional wisdom says a metal’s ability to withstand friction is based on how hard it is. The Sandia team proposed a new theory that says wear is related to how metals react to heat, not their hardness, and they handpicked metals, proportions and a fabrication process that could prove their theory.

“Many traditional alloys were developed to increase the strength of a material by reducing grain size,” said John Curry, a postdoctoral appointee at Sandia and first author on the paper. “Even still, in the presence of extreme stresses and temperatures, many alloys will coarsen or soften, especially under fatigue. We saw that with our platinum-gold alloy, the mechanical and thermal stability is excellent, and we did not see much change to the microstructure over immensely long periods of cyclic stress during sliding.”

Now they have proof they can hold in their hands. It looks and feels like ordinary platinum, silver-white and a little heavier than pure gold. Most important, it’s no harder than other platinum-gold alloys, but it’s much better at resisting heat and a hundred times more wear-resistant.

The team’s approach is a modern one that depended on computational tools. Nic and Michael’s theory arose from simulations that calculated how individual atoms were affecting the large-scale properties of a material, a connection that’s rarely obvious from observations alone. Researchers in many scientific fields use computational tools to take much of the guesswork out of research and development.

“We’re getting down to fundamental atomic mechanisms and microstructure, and tying all these things together to understand why you get good performance or why you get bad performance, and then engineering an alloy that gives you good performance,” Michael said.

A slick surprise

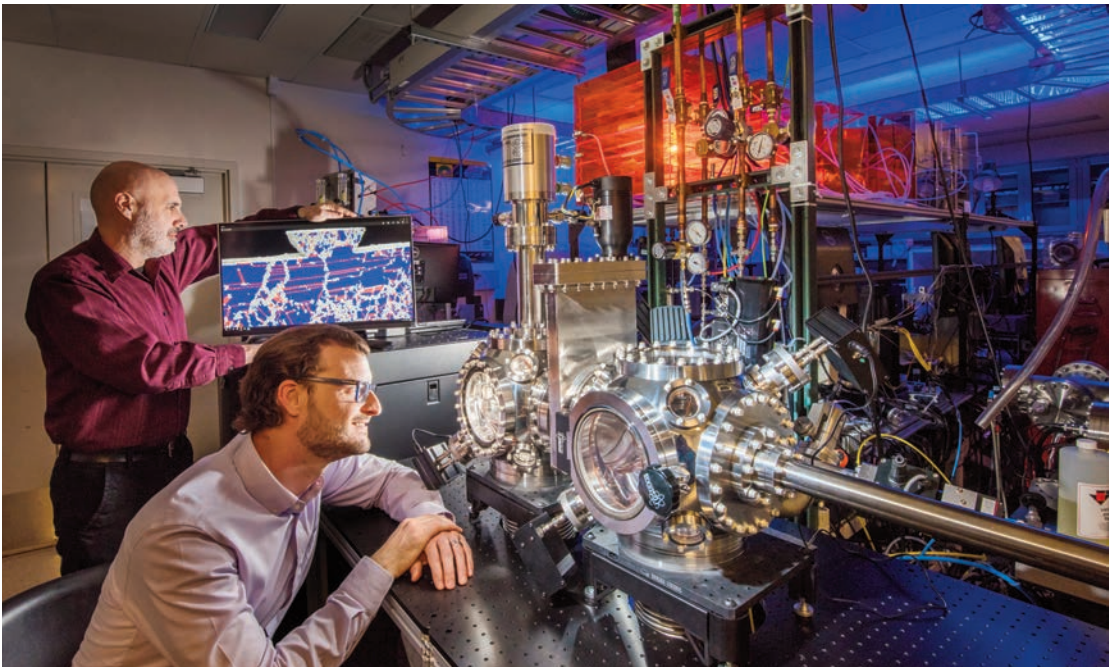
Still, there will always be surprises in science. In a separate paper published in *Carbon*, the Sandia team describes the results of a remarkable accident. One day, while measuring wear on their platinum-gold, an unex-

pected black film started forming on top. They recognized it: diamond-like carbon, one of the world’s best man-made coatings, slick as graphite and hard as diamond. Their creation was making its own lubricant, and a good one at that.

Diamond-like carbon usually requires special conditions to manufacture, and yet the alloy synthesized it spontaneously.

“We believe the stability and inherent resistance to wear allows carbon-containing molecules from the environment to stick and degrade during sliding to ultimately form diamond-like carbon,” John said. “Industry has other methods of doing this, but they typically involve vacuum chambers with high temperature plasmas of carbon species. It can get very expensive.”

The phenomenon could be harnessed to further enhance the already impressive performance of the metal, and it could also potentially lead to a simpler, more cost-effective way to mass-produce premium lubricant.



FIGHTING FRICTION — Researchers Michael Chandross (left) and Nic Argibay show a computer simulation used to predict the unprecedented wear resistance of their platinum-gold alloy and an environmental tribometer used to demonstrate it. (Photo by Randy Montoya)

Making it easier to get work done

By Janeen Miller

How do I report a lost Sandia badge? How do I order a new chemical for my lab? Can I accept payment for jury duty? What is the process for hiring a new employee? Can business and personal travel be combined?

And, finally, where would a member of the Sandia workforce find the answers to these and other commonly asked questions?

The new Laboratory Policy System

Making its debut last week, the Laboratory Policy System (LPS) represents almost four years of work to simplify and streamline Sandia’s policies and processes, with the goal of making it easier for the workforce to find the information they need to get work done.

Project beginnings

In August 2014, Sandia began a project that aimed to address workforce complaints about the complexity of Sandia’s Corporate Policy System, or CPS. Matt Schwartz, a policies and procedures analyst and manager in Policy Management, joined with Juanita Evans, Jeff Gilligan and Meredith Jones for a thorough review of the current system, and the policies, processes and procedures it contained. The team examined how policy leads processed changes. Then they researched policy systems at other large companies, including Honeywell,

Boeing and Pacific Northwest National Laboratory, to benchmark best practices.

“What we found at Sandia was a tangle of policies, managed by an extremely manual and cumbersome documentation system, located on an outdated information technology platform,” Matt said. “But we also found a starting point. The outstanding policy systems we reviewed were based on the needs of the customer. From that point on, our project team focused on how to make it easy for the workforce to find, understand and apply the appropriate policies and processes.”

In November 2014, the project team began working with Information Technology Services to track CPS user information. With several months of data, the team identified the Top 30: those policies and processes most requested by the workforce. Juanita Evans worked with the functional area leads to create succinct answers to frequently asked questions about those policies, which then were posted on a separate page on the CPS site.

“The creation of the FAQs page was just scratching the surface,” said Juanita. “We knew that we needed to make a more long-term plan for improvements — what we called the Corporate Policy System of the Future.” The team began gradual improvements by identifying policy leads for each functional area, migrating content to a new technology platform, and reviewing and consolidating the corporate dictionary with the 40,000-entry acronym database.

Gaining speed

After adopting a more customer-oriented business taxonomy developed by Sandia IT and now used throughout the national laboratories enterprise, the CPS-F team began working with policy leads, subject matter experts, attorneys and managers across Sandia to streamline and integrate policies and processes.

“It made sense to organize the information how customers use it,” Meredith said. “Let’s say I wanted to purchase a chemical. I would need information about purchasing, environmental considerations, training, storage and more. LPS displays the information as a process, with links and information all in one place.”

A push for the team came in May 2017, during contract transition, when the new leadership team began reviewing Sandia’s

policies and processes. Deputy Laboratories Director Dave Douglass recognized the need for simple, consistent policies and processes, and helped accelerate the project by naming it one of the new leadership’s top five initiatives.

“Having that kind of focus on our project was both helpful and a little intimidating,” Matt said. “We did get more support. And we had the opportunity to take a step back and see how the Laboratory Policy System, what we named the new corporate policy system, could be a part of a larger, Labs-wide risk management system.”

Part of a larger plan

The new LPS runs on the RSA-Archer platform, a technology that integrates LPS data with a suite of governance, risk management and compliance tools. RSA-Archer can house similar modules such as risk management, issues management, assessments and lessons learned, enabling a more comprehensive, Labs-level look at policy effectiveness and risk management.

“Policy management is just the first part of this connect-the-dots project,” Matt said. “RSA-Archer will be able to share data between LPS and the other modules to give us a holistic view of how we manage risks at Sandia.”

“It was also already in use in our cyber department, so we got a good price,” he chuckled.

Defining success

Now, when Sandia users need to find the answer to one of those frequently asked policy or process questions, they will find a policy system that is more intuitive, with familiar policy categories and improved contextual searches along with cross-division processes that integrate multiple tools.

“If our workforce can find what they need when they need it, with a minimum of confusion and clutter, we will consider the LPS a success,” Matt said. “The resulting efficiencies, cost-savings and consistencies are not glamorous or earth-shattering, but they are indicators of a well-run, safe and secure laboratory. That’s a win in my book.”

The next phase of the corporate policy simplification project includes further enhancements to the LPS platform, user-experience improvements and additional FAQ entries, with completion planned at the end of FY19.

Find the Laboratory Policy System by clicking on the “Policies” link on the Techweb homepage. Send questions about LPS or suggestions for improvement to cps1@sandia.gov.



TEAMING FOR SUCCESS — Matt Schwartz (left), Juanita Evans (center) and Meredith Jones discuss the new Laboratory Policy System, which features streamlined policies and processes and a new user-friendly design.

(Photo by Randy Montoya)

Calling 'Space Blimp' mission control

Intern coding challenge takes to the air

By Mollie Rappe
Photos by Norm Johnson

Undergraduate and graduate computer scientists became air traffic controllers in a fictional futuristic city for a day as part of Sandia's fourth coding challenge.

Ellen Voegtli, part of the System Mission Engineering Recruiting team, ran the challenge to identify and recruit potential Sandia scientists.

The theme of this and previous challenges was "Space Blimp." The students were to write code to help a fictional space blimp manage sky blimp traffic. The challenge is broken into three sections, each with three subtasks — an easy task worth one point, a medium task worth three points and a hard task worth five points.

"The space blimp scenario is somewhat goofy, but it's a great way to represent our center's work in an unclassified manner while also gauging students' talent for the kinds of tasks we do," said Ellen, a computer scientist and lead for this challenge.

"Coding challenges are fairly common recruiting tools," added Antonio Gonzales, a computer scientist who led the three previous Space Blimp challenges. "But they tend to be pretty generic. Space Blimp is something different and a fun, four-hour event the students are excited to do."

The beginning...

Walking into the lobby of the Lobo Rainforest building 30 minutes into the challenge, I was confronted by the dull roar of about 65 computer science interns collaborating and debating on how to program solutions to the nine problems. Spread about the lobby were 17 teams of three to four students, clustered around small tables with laptops and preferred beverages. They all were primarily from the Technical Internships to Advance National Security program, called TITANS, a mix of undergraduate and graduate students from the Labs' mission divisions.

There was a spread of coffee and bagels laid out in the center of the room and a constantly updating leaderboard. By the time I arrived, about half of the teams had correctly coded one of the easy tasks and had one point. One team, called Matdab, had jumped to an early lead by solving one of the easy tasks in 14:29.

About half a dozen Sandia moderators wandered through the crowd observing and answering questions. This, I knew from Ellen, is how the moderators really get to know how the participants think as well as learn the team dynamics.

Matdab team members Suhas Raja and Vinay Shah, both undergraduates from the University of Texas at Austin, were trying to figure out how to move the space blimp to track their targets.

Suhas waved down moderator and computer scientist Nick Blazier, who was also on the recruiting team, to ask for help on this task.

"Where do you want it to move?" asked Suhas.

"That's up to you," replied Nick. "That's the challenge."

As he left, Suhas and Vinay began debating how to implement his hints.

... the middle...

About an hour in, the team Michael Scott Paper Co surged into the lead with 5.66 points — the grading program they use for these challenges awards partial credit for the medium and hard tasks — and maintained that lead for a good hour while the other teams slowly caught up. Eventually, team lil_bobby_tables gained 5 points, red_team 4.58 and BlkejkeUndergrds 4.53.

Michael Scott Paper Co, comprising undergraduates Caroline Kish from the Georgia



GROUND CONTROL — Members of team Matdab, Suhas Raja and Vinay Shah, both undergraduates from the University of Texas at Austin, ask moderator Nick Blazier about one of the challenges.

debating whether one problem would be easier to solve in a different programming language. The platform used for the challenge allows participants to use whichever programming language they are most familiar with.

"We're about to crack a couple," Vinay said.

Around 11:30 a.m., Associate Labs Director for Mission Assurance Mark Sellers — and the pizza — arrived. Mark talked with a few of the teams and then addressed the whole room.

When Mark spoke with team Marai_SNL, Mel Savich, a Critical Skills master's program student at New York University, explained how they were pair programming, that C++ was a better programming language for this kind of task than Python and what "rubber ducking" is. Rubber ducking is a method of debugging code by explaining each line of the code to an actual rubber ducky. Her teammate, Claire Seiler, an undergraduate at the University of Florida, served in the role of the illustrious waterfowl.

Mark told the collected group of interns to keep an eye out for Sandia computer science job postings if they were approaching their last year at school. For those farther away from graduating, Mark said the TITANS 2019 posting should be up soon and he was hopeful that interns re-upping for next summer would have an answer by the end of this summer. Applicants for the Sandia-wide job postings would get the opportunity to talk to folks from around the Labs and find where they best fit.

... the end

After Mark's announcement and lunch, Matdab team member Vinay said that he spent 95 percent of his time debugging.

Antonio explained to Marai_SNL that they were going about the first task of the detection problem incorrectly, and hinted at a different approach.

Then Michael Scott Paper Co completed a five-point question, leaving back into the lead. Mahimna exclaimed, "And that's how it's done!"

Ellen announced that the teams had 30 minutes left. Tensions escalated.

"Oh man, my head hurts," said one student.



AYE, AYE, CAPTAIN — Associate Labs Director for Mission Assurance Mark Sellers talks with Marci McBride, an undergraduate at the New Mexico Institute of Mining and Technology, and Matt Crepeau, an undergraduate at Carnegie Mellon, both on team Marai_SNL.



PAPER TRAIL — Team Michael Scott Paper Co is hard at work even after securing a solid lead.

The leaderboard took on a life of its own, the top five teams changing every 15 to 30 seconds as teams solved or partially solved hard tasks. The moderators hovered around the board, watching the upsets and overthrows.

When Ellen announced that 15 minutes remained, tensions ramped up further and the room got louder, something I didn't think possible.

The teams programmed with single-minded focus, when not arguing or debugging together. Then the clock stopped.

Team 00BFFF, hexadecimal for deep sky blue, claimed first place with 18.87 points. Sorrow_plots claimed second with 15.76, and lil_bobby_tables came in a close third



SKY ADMIRALS — Members of winning Team 00BFFF (hexadecimal code for deep sky blue), concentrate intensely.

with 15.32 points. Michael Scott Paper Co trailed in fourth with 10.66 points, unable to finish that last hard problem.

Caroline left quietly, visage steely, while the top three teams were awarded their "Sky Admiral" certificates — the main award, asserting the participant was a Sky Admiral first, second or third class. They also received Sandia shirts, water bottles or keychains. Olympic athletes often say that receiving a silver medal is the worst place of all, being narrowly denied the gold. I wonder if that's how the members of Michael Scott Paper Co felt.

BlkejkeUndergrds placed fifth with 8.37 points, red_team placed sixth with 7.97, script_kadies seventh with 7.50, the_senate eighth with 7.48, Matdab ninth with 7.37, and Marai_SNL tenth with 6.94 points.

Previous and future challenges

The Space Blimp coding challenges got their start in 2017 when Senior Manager Eunice Young started several strategic planning initiatives for her group, including an initiative to improve recruiting in the critical — and notoriously difficult — computer science area. Antonio, a member of the planning team, said all of the big-name companies are also looking for the top coders, and Sandia lacks their name recognition or extra perks.

The goal for the System Mission Engineering recruiting team — including Antonio, Ellen, Nick and William Boone, another computer scientist — was to make Sandia's recruiting stand out through all of the competition.

The coding challenge was started under Lorraine Baca. The Space Blimp coding challenge was their solution. The team created a challenge that provides context to help students understand how large software systems come together. At the same time, it provides an opportunity for recruiters to observe the students' skills and how they work within teams.

In June 2017, the recruiting team ran its first coding challenge with about a dozen TITANS interns. They gleaned a lot of feedback from the first challenge and refined the tasks.

In November 2017, the recruiting team held the

second coding challenge at UNM, with 37 students participating. The UNM challenge led to the hiring of one summer intern and two year-round interns, one of whom eventually became a full-time employee. Several other applications were received as a result.

The third coding challenge was held at NM Tech in February, with 24 students participating. Though the deadline for summer internship applications had passed, the challenge was still productive and students asked when next year's event would be.

This fall, the Sandia team plans to hold coding challenges at Georgia Tech and the University of Arizona, its first out-of-state events. Ellen prefers that students sign up in advance for the challenges to aid in planning, but they won't be turned away if they show up on the day of the challenge.

Ellen hopes someday to take the coding challenge to her alma maters, the University of Southern California and the University of Michigan, after rolling it out to other out-of-state Academic Alliance schools.

"It's a big leap to go out of state, where there's less name recognition, and it may be harder to compete for attention with big name companies," said Antonio, "But I have a ton of faith in Ellen."

The coding challenges were funded through a variety of internal funds from Eunice Young; John Zepper, director of System Mission Engineering; and Human Resources.



SAFE LANDING — Ellen Voegtli hands out Sandia swag to the third place team, lil_bobby_tables.

Sandia certifies again for 'gold' environmental standard

By Manette Newbold Fisher

Sandia Labs once again has achieved certification for the internationally agreed-upon environmental standard that sets requirements for environmental management systems around the world.

Certifying to the updated standard, ISO 14001:2015, was a goal of Sandia's Emergency Management System (EMS) team this fiscal year and beyond, said Ben Henning, environmental technical professional in Environment, Safety and Health. He referred to ISO 14001 as "the gold standard" for EMS programs.

The standard, established and maintained by the International Organization for Standardization, aims to improve environmental performance through more efficient use of resources and reduction of waste, and can bolster the image of organizations that become certified.

"The certification is basically how we maintain our international legitimacy," Ben explained. "It lets everybody know globally that we are meeting a certain standard of rigor and excellence. That's really why the certification is so prestigious. It's an external marker of our level of environmental excellence."

Help for every division

The EMS team supports all Sandia divisions in developing, implementing and tracking annual environmental objectives and targets. In just the last five years, Ben said EMS recognized major improvements upon Sandia's environmental impacts that have resulted in cost savings of more than \$23.5 million, a reduction in water use of 9.82 million gallons, diversion of more than 460 tons of waste from the landfill, energy savings of 4,000 megawatt hours and elimination of more than 7,000 metric tons of greenhouse gas emissions.

"It's not just about what we have achieved as a laboratory, it's how can we continue to do better?" We have corporate objectives and targets, which are established by

both DOE and through the EMS and Sandia as a whole," said Chris Catechis, EMS program lead. Divisions also develop their own objectives and targets, such as 90 percent accuracy of chemical inventories, reduction of single-user printers and reduction of plastic foam use and waste at the cafeterias, Chris added.

"ISO is the gold standard," Ben said. "That ends up being very important to our ability to attract customers, and ultimately to the confidence that end users have in any solution that Sandia provides for them."

Staying certified

Other ISO standards look at different types of management systems, such as ISO 9001 for quality management

and ISO 45001 for occupational health and safety. Like all ISO management system standards, ISO 14001 requires continuous improvement of an organization's systems and its approach to environmental systems.

All ISO standards are reviewed every five years to keep them relevant for the marketplace. However, ISO 14001 hadn't been updated since 2004. Sandia California certified for ISO 14001:2004 in 2006, with Sandia New Mexico following in 2009. Both sites continued to certify every three years until 2015 when the site-specific EMS programs merged and Sandia obtained a single multi-site ISO 14001 certification.

Organizations are granted a three-year transition period once the revision has been published to migrate to the new

edition of the standard. Among the 2015 changes that affected Sandia were increased prominence of environmental management within Sandia's strategic planning processes, greater focus on leadership awareness and involvement and a new communications strategy to educate the workforce.

Chris said by October 2018, all labs in the DOE complex will need to have been audited to the ISO 14001:2015 standard, though they are not required to certify. Sandia sites in Nevada, Hawaii and Alaska, while a part of the corporate EMS, are not ISO-certified. Under an agreement with the DOE Sandia Field Office, the Nevada and Hawaii sites undergo an internal audit to the requirements of the ISO 14001 standard every three years.



SIMPLE SOLUTIONS, BIG IMPACTS — Jeffrey Zirzow discovered a way to save power and millions of gallons of water per year through a simple temperature chamber adjustment. Leaving the chamber door slightly ajar prevents the water heater from over-shooting, which stops the chamber's cooling system from automatically turning on and adding additional tap water to the system. This is one of many examples showing Sandia's commitment to reducing the Labs' environmental impact, one of the requirements for meeting the ISO 14001 certification. (Photo by Randy Montoya)



CLEARED FOR TAKEOFF — Participants of the coding challenge collaborate. The students' goal was to write code to help a fictional space blimp manage sky blimp traffic.

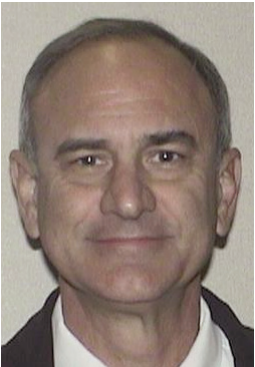
Mileposts



New Mexico photos by Michelle Fleming
California photos by Randy Wong



Darrell Kirby 35



Charlie Robino 30



Lonnie Trujillo 40



Ralph Candelaria 35



Stephen Kleban 25



Tom Vieth 25



John Ball 20



Heidi Herrera 20



Kevin Stamber 20



Dana Grisham 15



Todd Harrison 15



Sheryl Lawson 15



Beverly Manuelito 15



Jordan Massad 15



Phillip Reu 15



Richie Spangler 15

Recent Retirees





Heidi Ruffner 24

Former Sandia intern crowned Miss New Mexico

By Meagan Brace

Ashley Fresquez, a former Sandia intern, has been crowned Miss New Mexico 2019 and will represent the state at the Miss America competition in Atlantic City, New Jersey, on Sept. 9.

A communications major at the University of New Mexico, Ashley was a student intern with Sandia’s Energy Storage Program in fall 2017.

In partnership with the American Heart Association, Ashley’s personal mission is to develop a heart-healthy framework for New Mexico by creating awareness of heart disease and advocating for life-saving legislation.

Ashley advocated for legislation in 2015 and 2016 that helped expand sources of accreditation for stroke centers, set pre-hospitalization protocols for emergency medical services providers and required New Mexico schools to train students in emergency life-saving techniques.

In addition to advocating for heart health, Ashley completed humanitarian work in Ecuador over two summers and studied ballet in New York City.

The non-profit Miss America organization is an advocate for women’s education and a provider of scholarships. Ashley has been awarded more than \$15,000 in scholarships from the program.



MISS NEW MEXICO 2019 — Former Sandia intern Ashley Fresquez is the next Miss New Mexico and will represent the state at Miss America in September. (Courtesy photo)

CA Talk: Author to discuss combatting religious extremism

Karima Bennoun, University of California, Davis, professor of international law and expert on human rights, will discuss her book, “Your Fatwa Does Not Apply Here,” at 1 p.m. Thursday, Sept. 6, in the 904 auditorium at Sandia California, as part of Sandia’s Bay Area Strategic Engagement Seminars series. The book summarizes the results of 300 interviews Bennoun conducted with people of Muslim heritage from 30 countries about their efforts to counteract fundamentalist oppression.

Bennoun undertook her epic journey from Mali to Afghanistan and beyond out of her frustration with “stagnant, politicized public dialogue about the clash of civilizations.” Her extensive fieldwork and interviews help illuminate the stories of people fighting for their freedom worldwide.

Seminar organizers welcome suggestions for future speakers. Contact Andrew Kosydar or Anthony Juarez.

Sandia communicators excel in national APEX contest

by Neal Singer

Sandia communicators have garnered five awards in the APEX 2018 contest, the 30th annual national competition recognizing outstanding work by professional communicators, sponsored by Communications Concepts. More than 1,400 entries were received for this year’s competition.

Sandia winners of APEX awards for publication excellence were as follows:

Grand award

Social media

Darrick Hurst and Valerie Larkin, “Sandia’s Social Media.”

Only six other national social media programs or campaigns were recognized with the APEX grand award — the highest honor — including the Facebook site for NASA’s Armstrong Flight Research Center and the National Association of Realtors. This is the third time the Sandia social media team has won the grand award in recognition of their strategy and implementation.

The judges wrote: “Over 230,000 total social media followers rely on Sandia to provide a wealth of information including everything from news releases and

announcements, world-renowned photography and video to direct messaging, chats and contests. The extreme care and attention given to strategy and content planning is evident throughout each of the numerous social media platforms. Sandia clearly accomplishes the goals it has set with regard to using social media for PR, recruiting, crisis communications and thought leadership.”

Awards of excellence

Feature writing

Nancy Salem, “We remember Christopher: A tale of friendship, loss and love.” A Sandia veteran, John Bailon, recalled the story of one Marine’s death and the friend who carried his legacy through family.

Technical and technology writing

Jules Bernstein, “Testing for Zika virus: there’s an app for that.” Sandia has developed a smartphone-controlled, battery-operated diagnostic device that weighs under a pound, costs as little as \$100 and can detect Zika, dengue and chikungunya within 30 minutes.

Neal Singer, “HADES creates alternate reality to mislead hackers.” Rather than simply blocking a discovered intruder, Sandia deploys a recently patented alternative

reality... which feeds a hacker not what he needs to know, but what he wants to believe. “Deception is the future of cyber defense,” says researcher Vince Urias.

“Green” writing

Neal Singer, “The destructive effects of supercooled liquid water on airplane safety and climate models.” Supercooled water sounds smooth enough to be served at espresso bars, but instead it hangs out in Earth’s atmosphere, unpredictably freezing on airplane wings and hampering the simulations of climate theorists.



SANDIA CLASSIFIED ADS

MISCELLANEOUS

ARMOIRE/ENTERTAINMENT UNIT, 47"W x 23"D x 62"H, solid wood, very good condition, \$150. Atenci, 505-249-8395.

BENCH GRINDER, 6-in., 2 wheels, 4-in. portable cable ELE grinder, \$25; laminated wood header, 1" x 12" x 20", \$85; metal filing cabinet, 4 drawers, \$65. Garcia, 505-554-2690.

MINI DOXIE PUPPIES, grey dapple female, black male, 10 mos. old, in Sandoval Co. Gallegos, 505-239-1799, ask for Liz.

SLEIGH BED, full size, memory foam mattress, Ashely Furniture, photos available, \$300 OBO. North, 505-514-7878.

MICROWAVE, GE, over-the-counter, stainless steel, 1.5-cu. ft., \$100. Padilla, 505-296-5048.

WASHER/DRYER, Whirlpool, electric, large capacity, energy efficient, programmable, steam refresh, moving sale, like new, \$450. Ashton, 480-259-9446, send text.

GE APPLIANCE SUITE, white, refrigerator, gas stove, microwave, dishwasher, all in great condition, \$600. Garcia, 505-366-4322.

LEER 100XR SHELL, white, fits 5-ft. '05-'15 Tacoma, slider windows, dome light, factory roof rails, \$1,000. Holt, 505-350-7868.

BASKETBALL HOOP, outdoor, full-size, great condition, \$20; tether ball pole, homemade, moveable, \$10. Martinez, 505-792-3608.

FABRIC STEAMER/WRINKLE REMOVER, Norelco Travel Care TS60, boxed, w/pouch & instructions, excellent condition, \$22. Wagner, 505-504-8783.

TREADMILL, Landice L7, rarely used, like new, original price >\$3,000, asking \$1,100 OBO. Lin, 505-797-1567.

CRIB & MATTRESS, used 1 night, \$150; BoB jogger stroller, \$150; Thomas wooden train set, \$40. Chow, 505-286-2570.

DINING TABLE, 4-ft., w/chairs, 1 for inside, 1 for outside, \$60 ea. Fuller, 505-401-7289.

FAX MACHINE, Brother model 1270, \$20. de la Fe, 505-459-4685.

CAR MATS, Infiniti, all-weather, for sedan, black, \$40. Hall, 505-280-4344.

NIKON LENS, for digital SLR, 70-200 mm zoom, f/2.8G EDVR II AF-S, Nikkor, \$1,700. Barry, 505-220-6783.

DINING SET, oak table w/6 chairs, 2 leaves, matching 2-pc. buffet, \$500; rustic wood armoire, 6-ft., Spanish-style, for clothing/entertainment center, \$250; both good condition, photos available. Cisar, 505-899-9116.

TRANSPORTATION

'08 LEXUS RX300, 139K miles, great condition, clean car, runs great, \$8,000 OBO. Sena, 505-901-1391.

'11 TOYOTA SIENNA LE, V6, AT, 105K miles, \$11,995. Jones, 505-839-4180.

'04 TOYOTA SIENNA, good shape, mechanically sound, 165K miles, \$4,300. Colborg, 505-604-4915.

'11 KIA FORTE KOUP, great condition, at KAFB auto lot. Bosey, 575-491-1142.

'66 CHEVELLE, Malibu, project car, 2-dr., hard top, 396, 350TH, PS, PB, Hooker/3-in. exhaust, \$12,000. Bell, 505-730-4201.

RECREATION

'11 JAYCO GREYHAWK, GPS, 2 flat screen TVs, rear & side view cameras, 19.5K miles, \$65,000. Romero, 505-261-3980.

'14 SCATTANTE W570 ROAD BIKE, very low mileage, aluminum frame, carbon fork, Shimano components, best offer. Dennett, 505-379-9971.

'07 5TH WHEEL TRAILER, 33-ft., 3 slides, good condition, text for photos, more info, \$10,000. Garcia, 505-699-6844.

How to submit classified ads

DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

- EMAIL: Michelle Fleming (classads@sandia.gov)
- FAX: 844-0645
- MAIL: MS 1468 (Dept. 3651)
- INTERNAL WEB: From Techweb search for 'NewsCenter', at the bottom of that page choose to submit an ad under, 'Submit an article'. If you have questions, call Michelle at 844-4902.

Because of space constraints, ads will be printed on a first-come basis.

Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

'02 ENDEAVOR, 36-ft., diesel pusher, 8.3 Cummins Allison, 6-spd. transmission, model 36P8D, 49,392 low miles. Pierce, 505-239-5533.

REAL ESTATE

3-BDR. HOME, 2-1/2 baths, 2,019-sq. ft., big lot, lots of upgrades, Volterra, 5 mins. from base, \$299,000. Montoya, 505-514-2537.

7-BDR. HOME, 5 baths, 4,300-sq. ft., pool, Taylor Ranch, Volcano Vista High School, \$399,000. Duran, 505-220-6675.

2-ACRE BUILDING LOT, Sandia Park, mountain views, custom homes, utilities, near Crest Road, \$120,000, low down. Mihalik, 505-816-8469.

WANTED

SCOOTER, 50cc, running or w/minor tune-up would be great, reasonable price. Valencia, 505-228-7037.

VOLUNTEERS, to help Fabulous Felines w/kittens, <http://fabulousfelines.org>. Stubblefield, 505-263-3468, fabulousfelines@comcast.net.

TENTS FOR 4+, for Girl Scout Troop 10414, to replace damaged equipment. Guzzetta, 505-286-1934.

SUBARU, <100K miles. Singer, 505-298-5141.

PHYSICS TUTOR, for high school junior, 1 hr. per week, 3 p.m., Tues. Wed. or Thursday. Putelli, 505-328-3120.

ROOMMATE, share home, starting mid-January, reduce cost of living, save money. Burgett, 505-205-5070.

Dr. Andrew Hsi
*Director of the Health Sciences
Institute for Resilience Health and Justice*

Monique Jacobson
*Cabinet Secretary
Children, Youth & Families Department (CYFD)*

Hosted by Mark Sellers

Sandia National Laboratories

Wed, Sept. 12th | 2:00-3:15
Steve Schiff Auditorium

Join us for an informational talk about Adverse Childhood Experiences (ACEs), their long-term effects on children and adults, and an overview of childhood protective services in New Mexico. An agency/volunteer opportunities fair will follow in the lobby where employees will learn how they can help kids in crisis.

Blast tube

(Continued from page 1)

Analysts process experimental data using embedded information, and use signal processing methods identical to the experimental and analysis data to compare responses and assess the credibility of the model.

"The objective is to develop validated analytic models for predicting responses to blast loads with a high degree of confidence," Wil said. Researchers can use the validated model to help qualify a weapon to hostile blast environments that cannot be directly simulated with ground-level blast tube tests.

Planning takes much longer than test itself

Instrumentation is critical. Tests that last mere milliseconds require months of planning.

"Communication and technical excellence are crucial to success," and there's only one chance at getting data from the extreme environment of a blast, said John Griffin of Measurement Science and Engineering. "Simplicity in the design, protection of the hardware,

redundancy of critical elements and thorough verification of connections are key to ensuring that we get the data in that one opportunity."

Over the past three years, Sandia developed a new mobile instrumentation unit, a large-data acquisition system designed to self-check the accuracy and "health" of connections before and after testing.

A hardened trailer encloses the system so it can be placed near a blast test. The system can store up to 16 million samples per channel and record about one gigabyte per second at the maximum sample rate. For comparison, he said, this equates to more than 70 hours of digital music, or about 1,100 songs.

Nathan said it's more of an art than a science to measure pressure pulses. "If you don't have it set up right and mounted right, the data is worthless," he said. "There are racks and racks of instrumentation with wires coming at you. It makes your head dizzy just looking at it."

Specialty high-speed imaging employed

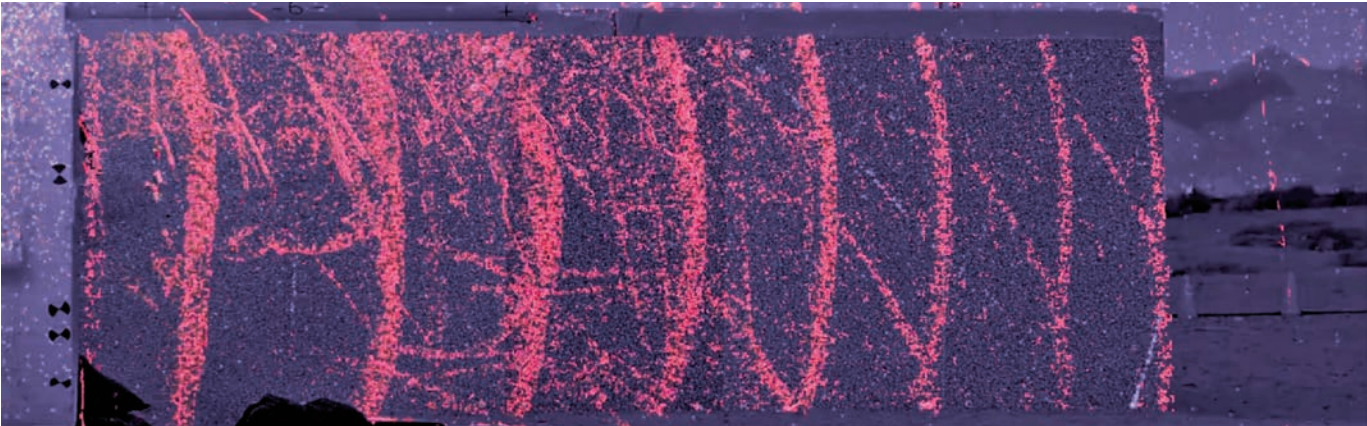
High-speed imaging that measures pressure changes also helps assess a shock wave's impact. In the past, researchers used streak cameras that viewed images through a quarter-inch by 6-inch slit. Streak cameras are similar to document scanners, imaging a column of pixels and generating an image by the object moving rapidly past the scan.

Now, a photographic technique called synthetic schlieren, implemented for harsh environments by optical engineer Anthony Tanbakuchi, enables a much larger view. Synthetic schlieren detects changes in optical index induced by changes in pressure, temperature and density. The schlieren effect is comparable to seeing ripples from heat on a road. Regular schlieren (a German word that means streak in the singular) techniques require large optics, special lighting and other complex, sensitive optical configurations that aren't practical for large-scale tests, Anthony said. Synthetic schlieren doesn't require any special setup other than an optional background and has no size limit because it looks for subpixel shifts in the background to detect optical index changes.

The team combines synthetic imaging algorithms with quantitative image stabilization codes Anthony

developed to image a blast wave front. Sandia's 50-year history of extreme testing means it has a huge code base to solve these problems.

Synthetic schlieren can be used for everything from pressure to temperature imaging. "But the most value comes when we also combine it with the data fusion techniques we've developed so you can see the pressure wave fronts with instrumentation data and model data," Anthony said. "That's when the full picture really emerges."



TUBE SHOCKS — Sandia researchers use wavefront imaging taken at 35,000 frames per second to analyze blast wave dynamics invisible to the eye and determine how well nuclear weapons could survive a shock wave. (Photo courtesy of Sandia National Laboratories)

Shocking experiences bring intern back for more

A civil engineering student returns to Sandia each summer for love of community, mountains and explosions

By Troy Rummler

If you didn't know better, you'd think Rebecca Nylen had a terrible start to her summer internship.

She didn't understand the work her group did. She had to be escorted everywhere because she worked in a tech area without a clearance. She tried picking up trail running, but fire restrictions closed the trails. When she joined a group of interns on a mountain climbing trip to Colorado, she tripped and broke her ankle.

But none of that mattered, she said. At least not compared to what she loved about the Labs — supportive people, world-class technology, Southwest sunsets. As she completes her second summer internship, she has every intention of returning to Albuquerque in 2019.

"I mean, it's Sandia," she said, surveying a bulging, six-foot-tall steel cylinder deformed from explosives.

Rebecca and her team sacrifice cylinders and other objects to refine the accuracy of computer simulations of damaging blasts, part of a field known as computational shock physics. But as a doctoral candidate in civil engineering at Georgia Tech, she's more of an experimentalist, pummeling materials like reinforced concrete with high-powered actuators to study how the materials deteriorate and how to improve their post-impact strength.

It took about a month, she said, to feel comfortable with the entirely new skills and computational techniques, but her teammates throughout the computational structural mechanics organization played a key role aiding her ascent along a steep learning curve.

"Rebecca brings a number of positive qualities to our team," said Russ Teeter, Rebecca's Sandia mentor. "She is self-motivated and excited to learn, while her background in civil engineering helps us when modeling blast effects on concrete."

Her expertise, he added, "fits into a number of Sandia mission spaces where it is important to understand the residual capacity of a structure after it has been subjected to blast or other damaging loads."

Now fluent in CTH, a widely used software tool for modeling the behavior of explosives, Rebecca enjoys chatting with developers, picking their brains about material characteristics and how they're represented mathematically. CTH was developed at Sandia, so the developers are always nearby to discuss the code. She can't do that for the commercial software she uses at Georgia Tech.

"Extending the network of sharing between academia and the national labs is important," said Rebecca's Ph.D. adviser Lauren Stewart, assistant professor in the School of Civil and Environmental Engineering at Georgia Tech, "and Rebecca will be able to return to Georgia Tech with new knowledge that she can share with our entire research lab. I look forward to her experiences and approaches stimulating new ways of thinking for our group."

And that's exactly what Rebecca plans to do. Civil



NERVES OF STEEL — Rebecca Nylen kneels next to blasted steel cylinders, some of her handy work as a computational shock physicist. (Photo by Randy Montoya)

engineering, she says, is largely driven by observation, but that makes certain scenarios hard to plan for. If you want to study a structure in an earthquake, you have to wait for an earthquake, and for obvious safety reasons, you can't intentionally build a bridge that will fall apart to study its weak points, or violate building codes to experiment with new materials or techniques.

But a computer model can reveal ways to improve roads, bridges and other infrastructure in ways that are otherwise difficult to observe. Rebecca aims to combine her experimental and computational perspectives to propel her field. "I'd like to advance the state of computational abilities for civil engineering structures."

Rebecca's ankle has long since healed. In fact, she used it to reach the summit of nine Rocky Mountain peaks this summer. Next year, she wants revenge on Mt. Elbert, the expedition on which she broke her ankle. She's also found it handy for escorting new, uncleared interns. Her advice to them: "Show interest in a subject, and there will be experts who will help you learn it."

If you're here next summer, Rebecca may be that expert.

Visitors study physics of Earth, exoplanet minerals under pressure

By Neal Singer

A band of physicists and students from universities and national labs visited Sandia's DICE and Z facilities in mid-August to improve their understanding of the composition of exoplanets and the Earth's deep interior. DICE is the Dynamic Isentropic Compression Experiments facility. Z is the most powerful

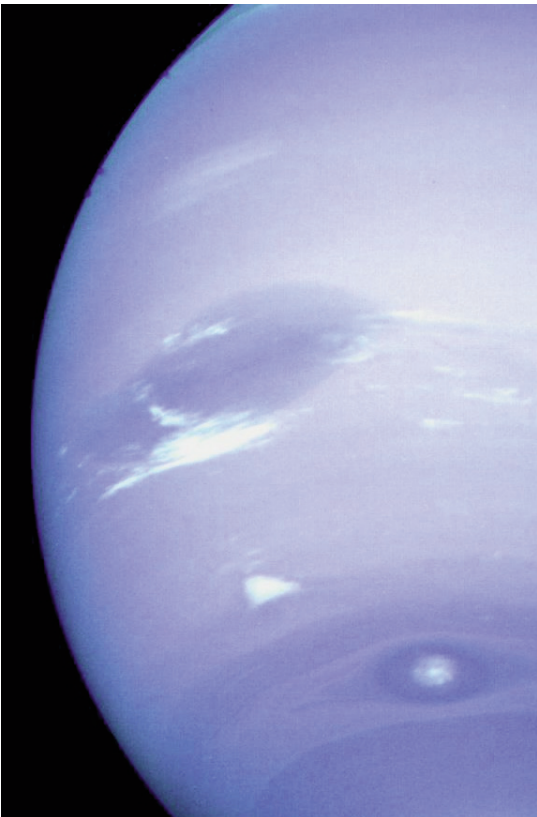
instantaneous X-ray source on Earth.

The visitors sought some idea of how the tremendous heat and pressure that Sandia's huge machines bring to bear on materials might provide data for otherwise necessarily theoretical calculations of the composition and evolution of Earth's interior and of exoplanets over geological time periods.

The visit capped a four-day physics conference, the Consortium for Materials Properties Research in Earth Sciences, held at the Santa Ana Pueblo, with about 100 researchers attending. Sandia researcher Seth Root, a

keynote presenter, spoke on "Using Sandia's Z machine and density functional theory simulations to understand planetary materials."

Says Seth, "One problem in which people are often interested is Earth's core composition. We know the core is mostly iron, but sound-speed measurements show it cannot be pure iron. So people try to understand different iron mixtures — iron with oxygen or sulfur or nickel, etc. — under high pressures and temperatures to explain the difference in sound speed from pure iron."



ICE GIANT — Planets like Neptune, seen here in a composite image constructed from two photos taken by the narrow-angle camera on NASA's Voyager 2, may have more water than previously thought. (Image courtesy of NASA)



CURRENT EVENT — Sandia researcher Randy Hickman points to the target chamber on the Veloce ("Swift" in French) mini-pulsar machine. Veloce uses electrical current to generate a sudden pressure wave that propagates through a material sample of interest. The machine can create an electrical current of about 2.2 megaAmpere, about one tenth of the current generated by Sandia's Z machine. (Photo by Randy Montoya)